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The expression of the Faraoni OAE (Late Hauterivian) in neritic environment: The formation of sedimentary discontinuity in the Western Swiss Jura and the Helvetic Alps

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First described in the Umbria-Marche basin of Italy (Cecca et al., 1994, Riv. It. Paleont. Strat.), the Faraoni level is characterized by the deposition of organic-rich sediments during a sea-level high, but with no major δ13C excursion, which is unexpected if compared to other Oceanic Anoxic Events (OAEs) occurring during the Cretaceous. Despite this paradoxical behaviour, geochemical studies confirmed that anoxia developed in the Pseudothurmannia ohmi zone, in sediments associated with the Faraoni level. The trigger for this palaeoenvironnemental crisis would be a climatic change toward more humid conditions and a subsequent enhanced input of nutrient in the ocean, leading to an increase in marine productivity. Although the onset and unfolding of this event are well constrained in hemipelagic and pelagic environments of the Tethys, the quantification of its impact on shallow-water ecosystems is less well understood, and requires an adequate correlation of both palaeoenvironments.

In the western Jura mountains and the Helvetic Alps of Switzerland, the carbonate platform that developed during the Early Cretaceous underwent several phases of retreat and subsequent drowning, especially in the Late Hauterivian, where heterozoan ecosystems characteristic of mesotrophic conditions ceased abruptly, and were subsequently topped by a well-expressed sedimentary discontinuity associated with a discrete condensation phase. This "hardground" is located at the base of the Urgonian formation in the Jura, and corresponds to the Altmann Mb in the Alps. Sequence stratigraphic analysis performed in sections from the Jura confirms that this discontinuity represents a sequence boundary, and thus cannot be considered as the equivalent of the Faraoni OAE in shallow-marine environments. However, the deepening-upward trend that follows on top of the discontinuity culminates within a glauconitic and clayey level, which thus represents a maximum flooding surface; biostratigraphical (calcareous nannofossils) and geochemical (Sr-isotope stratigraphy and K-Ar dating) constraints on the age of this glauconitic bed are coherent with the age of the Faraoni level derived from ammonite findings in deeper settings.

On the other hand, looking at the diagenesis of the "hardground" helped assessing its significance and relationship with the development of the Faraoni event. In-depth optical microscopy analysis revealed that a phase of dissolution, highlighted by the presence of a vadose silt and grain corrosion, followed an early phase of marine phreatic cementation. After a slight phase of compaction, lithophagous bivalves have perforated the indurated sediment, before its burial and the subsequent development of a blocky calcitic cement that occluded the remaining porosity. Oxygen and carbon stable-isotope analyses performed on this type of cement confirm its diagenetic interpretation. Finally, the subaerial phase associated with this discontinuity may have weakened shallow-marine ecosystems, which have thus become more sensitive to large-scale palaeoenvironmental perturbations such as the Faraoni event, and also may have prevented them from recovery before the installation of the humid climate and the onset of anoxic conditions.